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Migmatites revisited - the sub- to supersolidus transition in the central Pyrenees

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Partial melting is the key factor in intracrustal differentiation and in the transfer of many critical metals from the deepest continental crust to shallower levels via granitoids. These processes are recorded in deeply exposed migmatite and granulite domains of former mountain belts. Migmatites are sites of melt production, but are also affected by melt influx from deeper levels. Additionally, the restitic units and crystallizing melts frequently react at microscale and outcrop scale, leaving a retrograde overprint on peak mineral assemblages. We are investigating the interplay between pro- and retrograde processes and their effect on element transfers in a well-exposed transect from subsolidus to supersolidus conditions in the central Pyrenees.

The western Lys-Caillaouas massif and the adjacent Gavarnie-Héas metamorphic dome expose a Hercynian window below an Alpine nappe stack [1]. The area shows the transition from medium-grade metasediments to migmatites along a steep geothermal gradient at ~3-4 kbar. Prograde reactions include the (in)direct replacement of andalusite by sillimanite, followed by subsolidus muscovite breakdown to K-feldspar, and supersolidus breakdown of the assemblage biotite + sillimanite + quartz to cordierite (and/or garnet) ± K-feldspar + melt. Both areas have been intruded by a variety of magmatic rocks.

The complex interplay of prograde melt-producing reactions and retrograde melt-consuming reactions [2], as well as fluid release during melt crystallization, are summarized in a conceptual model for melt-mediated fluid transfer and recycling at the scale of samples, outcrops, and crustal section. We subdivide crustal sections above the melt-in isograd into three migmatite zones and an underlying granulite domain, and distinguish four retrogressive stages. The model serves as the foundation for quantifying element fluxes by a mass balance approach, including trace element redistribution. In some Pyrenean samples, retrogression can be fully attributed to fluids released from in-situ melts, whereas other samples require an additional external fluid source.

[1] Kilzi, Grégoire, Bosse, Benoît, Driouch, de Saint Blanquat & Debat (2016), *Comptes Rendus Geoscience 348*(2), 107-115.

[2] Kriegsman & Álvarez-Valero (2010), *Lithos* 116, 310-320.

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